

THE SHY ALBATROSS (*THALASSARCHE CAUTA*):

Population Trends, Environmental and Anthropogenic Drivers,
and the Future for Management and Conservation

Rachael Louise Alderman (B.Sc. Hons)

Submitted in fulfilment of the requirements

for the degree of Doctor of Philosophy

University of Tasmania

(May, 2012)

Declaration of Originality

This thesis contains no material which has been accepted for a degree or diploma by the University or any other institution, except by way of background information and duly acknowledged in the thesis, and to the best of the my knowledge and belief no material previously published or written by another person except where due acknowledgement is made in the text of the thesis, nor does the thesis contain any material that infringes copyright.

Rachael L. Alderman

Signed _____

Date _____

Statement of Access

The publishers of the papers comprising chapters two and three hold the copyright for that content and access to the material should be sought from the respective journals. The remaining non-published content of this thesis may be available for loan and limited copying and communication in accordance with the Copyright Act 1968.

Rachael L. Alderman

Signed_____

Date_____

Statement of Ethical Conduct

The research associated with this thesis abides by the international and Australian codes on human and animal experimentation, the guidelines by the Australian Government's Office of the Gene and Technology Regulator and the rulings of the Safety, Ethics and Institutional Biosafety Committees of the University.

Rachael L. Alderman

Signed_____

Date_____

Authorship and Contributions

The candidate contributed between 70-90% to each of the four data chapters in this thesis, including primary design, data collection, data analysis and writing. The candidate has been responsible for the co-ordination of the annual DPIPWE shy albatross monitoring programme since June 2003 and has collected all field-data presented in this thesis from the 2003 breeding season to the present day. This includes multiple island visits each season to conduct banding and recapture programmes, deploy satellite transmitters and undertake ground counts and aerial photographic surveys. Data prior to the 2003 breeding season has been collected by a range of personnel and was made available for use in this thesis by the DPIPWE data custodian, Dr. Rosemary Gales.

Two chapters in this thesis (chapters two and three) have already been published as:

- i) Alderman, R., Gales, R., Hobday, A.J. & Candy, S. (2010) Post-fledging survival and dispersal of shy albatrosses from three breeding colonies in Tasmania. *Marine Ecology Progress Series*, 405, 271-285.
- ii) Alderman, R., Gales, R., Tuck, G. & Lebreton, J.D. (2011) Global population status of shy albatross and an assessment of colony-specific trends and drivers. *Wildlife Research*, 38, 672-686.

The candidate is the primary author on both publications. Supervisors (R. Gales, A. Hobday and G. Tuck) are included as co-authors on publications for the provision of data (shy albatross data, fisheries data and remotely sensed oceanographic data respectively), their contributions towards developing the idea and subsequent refinement and presentation of publication chapters. External co-authors, J.D. Lebreton and S. Candy, provided assistance with models (survivorship models and

linear mixed effects models respectively). Relative author contributions on each publication are indicated below.

- i) R. Alderman (candidate) (80%), R. Gales (7.5%), A. J. Hobday (7.5%), S. Candy (5%)
- ii) R. Alderman (candidate) (85%), R. Gales (5%), G. N. Tuck (5%), J. D Lebreton (5%)

We the undersigned agree with the above stated “proportion of work undertaken” for each of the above published peer-reviewed manuscripts contributing to this thesis:

Signed: _____

Associate Professor Stewart Nicol

Professor Elissa Cameron

Supervisor

Head of School

School Of Zoology

School of Zoology

University of Tasmania

University of Tasmania

Date: _____

Thesis Abstract

Despite recent global conservation efforts, albatrosses remain amongst the most threatened groups of birds. Worldwide, they are affected on land and at sea by a range of processes, particularly fisheries bycatch. In spite of their high conservation profile, albatrosses present challenges for monitoring and recovery actions because they are long-lived, spend most of their life at sea and return to breed at colonies that are often located on remote, relatively inaccessible islands.

This thesis offers a comprehensive assessment of the population status and trends of Australia's endemic shy albatross, *Thalassarche cauta*, which breeds exclusively on three Tasmanian offshore islands. The main anthropogenic, physical and environmental processes that influence each of the three breeding populations are examined and the processes that shape key demographic parameters and trends are assessed in four analytical chapters which follow the introductory chapter.

Chapter two compiles and analyses available population and demographic data to provide the first comprehensive assessment of the status and trends of the three individual shy albatross colonies and of the species as a whole. This chapter shows that the Albatross Island population has recently stabilised following a period of sustained increase post-harvest and that this change in trajectory appears driven by a decrease in juvenile survival. The small Pedra Branca population is declining, likely due to reduced breeding success associated with the increasing population of Australasian gannets on the island. While trends for Mewstone, the largest breeding population, are unknown, it is shown that birds from this colony have greater exposure to commercial fisheries, are therefore at higher risk of fishing-related mortality and, consequently, survival rates for this population are likely lower than their Albatross Island counterparts. Collectively, these results suggest the current status of the shy albatross is likely to be stable at best and quite possibly decreasing.

The third chapter uses satellite tracking data to investigate the at-sea distribution of post-fledging shy albatrosses. Data show colony-specific dispersal behaviour and subsequent post-fledging range. Accordingly, the three populations differ in the extent to which juveniles overlap with commercial fisheries and their consequent risk of by-catch. The satellite data and supporting evidence from band recoveries also show that juvenile mortality is highest in the period immediately after fledging, with population differences in the frequency of mortality also apparent. Post-fledging mortality is likely related to foraging failure of naive birds and the observed population differences may be related to proximity of colonies to food resources. Considering the combined impact of environmental and fisheries influences, it is probable that the juvenile survival rates for the two southern populations, and for Mewstone in particular, are lower than the northern, well-studied, Albatross Island population.

In line with the increasing focus of managers and researchers on understanding climate impacts on threatened species, chapter four assesses the efficacy of existing long term monitoring on Albatross Island in detecting the influence of climate change on the breeding performance of this population. This study shows that the current sampling design is biased towards older, more experienced breeding individuals, which are better able to buffer the effects of climate variability and thereby obscure climate signals. Modifications to the monitoring protocols are suggested, including the deliberate sampling of younger birds to provide a more sensitive and effective ecological indicator of the effects of climate variability and climate change on this population.

The fifth chapter takes the existing breeding-success time-series and investigates the relationship of this important life-history parameter with a range of local and regional environmental variables. The strongest relationships were found with environmental conditions during chick-rearing, including rainfall and maximum temperature during this period at the breeding site, and with sea-surface height anomalies associated with increased upwelling in the primary foraging areas during both

incubation and the chick-rearing phases. The population implications of these climate-biology relationships given future predictions for climate change are considered.

These findings are synthesised to produce the first comprehensive report of the overall conservation status of the shy albatross and a key conclusion of this research is that the species is not as secure as previously believed. In addition to contributing to our understanding of the status of the species, this thesis highlights a range of threatening processes and their underlying mechanisms and provides clear guidance for future management and monitoring of this species, findings that can be extended to other threatened seabird species.

Acknowledgements

Many people have contributed to the monitoring and conservation of shy albatrosses over the years – particular acknowledgement must go to Nigel Brothers, Rosemary Gales, April Hedd and Sheryl Hamilton. I am privileged to have had the opportunity to build upon their dedicated efforts.

Ian Hay (DSWEPaC) has been steadfast in his support and funding for the shy albatross monitoring programme.

I thank my fabulous team of supervisors – Alistair Hobday, Rosemary Gales, Geoff Tuck and Stewart Nicol – for their input and support, my friends in team marine for their assistance and good times in the field and Michael Berry for his help and encouragement across the finish line.

Table of Contents

Declaration of Originality	ii
Statement of Access.....	iii
Statement of Ethical Conduct	iv
Authorship and Contributions	v
Thesis Abstract	vii
Acknowledgements.....	x
Table of Contents.....	xi
List of Tables.....	xv
List of Figures.....	xvi
Acronyms and Abbreviations.....	xix
1. Introduction	1
2. Global population status of the shy albatross and an assessment of colony specific trends and drivers	19
Abstract.....	19
Introduction	20
Methods.....	22
<i>Species information.....</i>	<i>22</i>
<i>Study sites</i>	<i>23</i>
<i>Population estimation methods</i>	<i>24</i>
<i>Capture-mark-recapture survival model</i>	<i>27</i>
<i>Assessment of fisheries overlap</i>	<i>31</i>
Results.....	34
<i>Population abundance estimates and trends.....</i>	<i>34</i>
<i>Survival estimates</i>	<i>37</i>
<i>Spatial and temporal overlap with fisheries – a source of mortality?</i>	<i>39</i>
Discussion.....	42

<i>Shy albatross population status and trends</i>	<i>42</i>
<i>Local population trends and colony-based influences.....</i>	<i>43</i>
<i>Fisheries influences</i>	<i>47</i>
<i>Conclusion.....</i>	<i>48</i>
3. Post-fledging survival and dispersal of shy albatrosses from three breeding colonies in	
Tasmania.....	50
Abstract.....	50
Introduction	51
Methods.....	54
<i>Transmitter deployment</i>	<i>54</i>
<i>Assigning mortality to tracked individuals</i>	<i>55</i>
<i>Data processing</i>	<i>57</i>
<i>Data analysis.....</i>	<i>58</i>
Results.....	61
<i>Flight characteristics</i>	<i>63</i>
<i>At-sea distribution</i>	<i>63</i>
<i>Patterns in spatial use.....</i>	<i>65</i>
<i>Changes in foraging behaviour with time since fledging.....</i>	<i>67</i>
Discussion.....	71
<i>Fledging and flight characteristics</i>	<i>71</i>
<i>Juvenile dispersal and colony differences.....</i>	<i>73</i>
<i>Habitat use.....</i>	<i>74</i>
<i>Comparison with adult distribution.....</i>	<i>76</i>
<i>Conservation implications.....</i>	<i>77</i>
<i>Survival implications</i>	<i>78</i>
4. Monitoring seabird populations to detect impacts of climate variability	79
Abstract.....	79
Introduction	80
Methods.....	84
<i>Study site - Albatross Island</i>	<i>84</i>

<i>Species monitoring on Albatross Island</i>	86
<i>Individual-based data</i>	86
<i>Population-based data</i>	87
<i>Analysis</i>	88
Results	90
<i>Relationship between area and bird age</i>	90
<i>Influence of age on breeding success</i>	91
<i>Influence of nest quality on breeding success</i>	93
<i>Factors affecting nest quality</i>	94
<i>Chick condition and parental experience</i>	95
Discussion	96
<i>Age effects</i>	97
<i>Factors influencing breeding success</i>	98
<i>Factors influencing chick condition</i>	99
<i>Implications for monitoring protocols</i>	100
5. Shy albatross breeding success: trends and climate influences	102
Abstract	102
Introduction	103
Methods	105
<i>Study site and breeding success estimates</i>	105
<i>Environmental data</i>	106
<i>Data analysis</i>	110
Results	112
<i>Breeding success temporal trend</i>	112
<i>Environmental variables</i>	112
<i>Model selection</i>	113
Discussion	116
<i>Population consequences of this decline</i>	117
<i>Relationships with environmental variables</i>	118
<i>Predicted changes in the variables</i>	120
<i>Consideration of other factors</i>	121

<i>Implications for conservation and management.....</i>	<i>122</i>
6. The future for the shy albatross: population status, monitoring and management	124
<i>Summary.....</i>	<i>124</i>
<i>Implications and applications for conservation and monitoring</i>	<i>127</i>
Bibliography	133
Appendix.....	149